

Integrating Conservation and Transportation Planning Through Decision Support Software Or The Missing Link Between Geodatabase & STEP UP?

NatureServe

What is a Decision Support System?

- Helps you do specific activities vs general tools
- Guides you through a process
- Incorporates expert knowledge/models AND user values
- Provides automation and documentation of the process



NaturéServe

Some Uses of DSS for Integration Conservation & Transportation

- Guiding least-conflict routing of transportation
- Rapid evaluation of multiple route options
- Integrating multiple objectives (e.g., transportation, development, conservation) for long-term plans or short-term projects
 - Predicting and evaluating long-term cumulative effects
 - Revealing areas needed (irreplaceable) for any particular objectives
 - Revealing options for achieving objectives to mitigate conflicts





Tool/Process Integration Demo

Method: Integration of Three Planning Tools



NatureServe Vista used to identify high conservation value areas



Transportation planning tool Quantm used to suggest transportation routes



Land use planning tool CommunityViz used to predict resulting urban growth



NatureServe Vista used to evaluate impacts of land use on conservation goals



About the Tools

- Quantm: transportation route optimization tool applied through a service contract
- CommunityViz: land use planning framework tool applied as desktop software
- NatureServe Vista: conservation framework tool applied as desktop software

None of these tools are required to do this analysis or any can be used in any combination with other tools. NatureServe Vista has no formal relationship or linkage to any of these tools.





What is Quantm?

- Worlds first advanced planning system for corridor and route optimization developed over 15 years by Australian Government and Quantm.
- Addresses complex route planning issues, investigating millions of alignment options.
- A tool that empowers Planning Engineers with the ability to consider "all reasonable alternatives", upfront and equally.
- Quantm provides training, support and system access the system is applied by the agency or appointed consultant

Facilitating integration of *all* planning aspects in a single analysis



Inputs to QUANTM

- Ø Terrain model (DEM and/or DTM)
- Ø Geology and Earthworks costs
- Ø Geometry
- Ø Structure Costs
- Ø Constraints
 - Linear engineering criteria
 - Zone environmental, biological, cultural, resource, mitigation, ROW, etc.



3-Dimensional analysis throughout

Quante Integrator [Scenario: IW_07].

Pie Mode Image Report Data View Window Help





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Alternative showing earthworks and constraints

| Quantm Integrator (Scenario | Disaggregated land clearing zones.txt - Notepad | | | |
|--|--|------------------------|------------------------------------|----------------|
| | File Elit Format View Help | | | |
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| Fnv | 35: Deergrass grassland 36: Undeveloped/Agricultural/Open Space 37: Residential | 0 ha 228 ha 0 ha | \$ 0 \$ 56,372,000 \$ 0 | 0 |
| | 38: Recreational (Golf Course, Parks) 39: Commercial/Industrial/Mixed Use | 7 ha 1 ha | \$ 12,280,000 \$ 4,782,000 | 382,000 |
| | 41: Undeveloped Residential | 0 ha 0 ha | \$ 1,595,000 \$ 0 | |
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About CommunityViz®

- GIS-based tool for geographic decisions
- Real-world 3D models
- Interactive scenario analysis
- Intuitive, powerful, and flexible
- Made available to the public at very low cost by the Orton Family Foundation



CommunityViz Growth Modeling Hypothetical "build-out" capacity for each scenario: Road Proposal 11 shown here. Note that "Avoidance" areas are constrained from building. Scenario A: Scenario B: Commercial and mixed-use zones Large-lot residential development Build-Out ☑ NatureServe Conservation Build-Out Buildings Cost Buildings Avoidence Building Use Building Use 🔯 High Cost Single-Family Residential Single-Family Residential Mixed Use Commercial Build-Out Buildings Build-Out Buildines 3,113 3.127 $\tau \in C$ 7,255 8.927 1.74 5.275 а ^{5,465} Я 4,554 - 4.102 £ 4 17 5 ₁₀₁₀ 2 2 2 1 4-24 3.142 13.24 1.82 Sorial. Sec. 14 Calculated Build-Out Floor Area Build-Out Floor Area 0.26232 9.00.00 1 512 51 6.046.27 114.01 P 11 14 2 TOOLS -. e 20e 10e 46.00254 5.08.205 4 372 - 53 Î a teres 115110 5.00110 our care \$211213 1,718,45 4-4-10 11.0.1.24 407 243 407 243 venerie Gestal Calculated Land Use Land Use Scenario A Scenario B

CommunityViz Growth Modeling

Results are available for all 4 scenarios.

Potential changes to policies and assumptions can still be tested and explored.



CommunityViz Growth Modeling

CommunityViz also estimates a wide variety of economic, environmental, and social impacts for each of the 4 scenarios:

Just a sample of the many impacts available, all variable by year and other assumptions, are shown here.







NatureServe's Conservation Planning Support System

| ite Inventory | | | | | | | |
|--|----------------------------|---------------------------------|---|--------|------------------|----------------|----|
| Scenario Evaluation N Site CA FG 8983; | lapa County - Baselir 2 | ne Selecta ▼ Parcel Owner | d Site Id: 2387 : California St. Fish and | l Game | × • | Set Up |) |
| Element Inventory Element Name | | Protection | Viability | Z | Respor | nse | |
| Northwestern Pond | <u>d Turtle</u> | | | _ | Incomp | atible | |
| Napa Western Flax | <u>×</u> | | | | Incomp Compat | atible ible | L |
| Cenario Composition | | | | | | | |
| Layer | Land Use | | Protection Policy | | | Previe | зw |
| State F&G Recreation and Open S StreamSetbacks.shp Biodiversity Conservatio | | en Space V rvation | Owned/Managed Local legislation | | | Appl | y |
| Slope_plus_50 | Biodiversity Consei | rvation | Local Legislation | | | Finish | |



About Vista

- Custom GIS application based as an extension of ESRI's ArcMap 9 with spatial analyst
- Licensed software with full integrated help manual, live technical support, available training
- Supports both conservation experts & planners/managers
- Incorporates expert knowledge/models AND user values
- Commercial grade design and engineering
- Provides automation, documentation, & repeatability of the process





Basic Vista Extension Components





Vista Status & Support

Software Versions

- Released Version 1.0 on March 1, 2005
- Version 1.3 released Mar 1 2006, 2.0 under development with possible release Mar 1 2007

Development Sponsors: ~\$3.4M versions 1-2.0



Development Partners

- Environmental Systems Research Institute (ESRI)
- University of California –Santa Barbara
- US Geological Survey Florida and Wyoming Heritage Programs

Endowment ~\$1.6M permanent maintenance and support

- Doris Duke Charitable Foundation
- The Nature Conservancy
- Centex



Applications So Far

- 20+ permanent licenses
- 100+ trial downloads
- 10+ direct NatureServe projects spanning:
 - Industry, government, NGOs
 - 30 k acres—12M acres
 - Forestry, Conservation,
 Land Use Planning,
 Public Land
 Management



Regional Context for Site Decisions

How to get from here...

to here



And from site decisions to roll-up of progress toward regional oals

Some Jargon

- Conservation Elements: the features you wish to conserve representing biodiversity & other conservation values
- Element viability/integrity requirements: representing the site or population needs for proper condition and minimum size
- Element conservation goals: representing the requirements for metapopulation persistence or ecosystem functioning in the planning region
- Compatibility: representing analysis of current or alternative futures to meet element requirements while maximizing options to meet other land use objectives
- Scenario: any mapped features representing land use or management practices, infrastructure, natural or human-caused disturbance, invasive species, pests, disease, etc.



Conservation Elements

Representing Composition, Structure, and Function of Regional Landscapes

- Species
 - Imperiled, Declining, Vulnerable, Endemic
 - Management Indicator Species
- Ecological Communities
 - Rare plant communities
 - Rare aquatic communities
 - Unique environments
- Ecosystems
 - Groups of communities interconnected on land and waterscapes;
 - Natural pattern and process at local scales useful for management and monitoring
- Non-Biological Elements
 - Scenic views
 - Historic & cultural sites
 - Valuable agriculture soils
 - Natural hazard zones









Defining Goal Achievement

Version 1:

- Adequate number of element occurrences or area in project region (metapopulation viability, ecosystem processes)
- Adequate size of occurrences (population potential, ecological functioning)
- Occurring in areas of compatible land use supported by reliable policies

Version 2:

- Same as version 1 plus:
- Adequate "condition" of occurrences (habitat quality)



Three Analytical Approaches

Increasing data requirements, complexity, integration





Where Does the Data Come From?

Scological Systems

Spatial distribution maps of each element come from:

- Heritage data
- land cover maps
- modeled distributions
- museum collections
- local information sources

Each element occurrence has:

- A viability/integrity score
- A confidence score

Modeled distributions



ialt March Darris (Mone) Scorreitan, Poisis Ichaid al Black Folger

Ecological systems



Species and community occurrences



Modeling Condition

Landscape Integrity Indices

- Combines land use, roads, infrastructure, pollution, etc.
- Model weights effects, adds distance effect
- -Can be elementspecific



Tool Interoperability Model

Diagram indicates interactions among Vista, Quantm, and CommunityViz. Bold lined boxes and arrows indicate primary path of information to be demonstrated.



Case Study

Objective: Plan new tech corridor and mixed use while respecting natural resources



Community Planning Collaborative 2005

This Report

This report includes a description of the Community Planning Collaborative (CPC) initiative and outcomes of its 5 phases. The main body of this report has 3 sections: 1) training and capacity building for the Orange County Planning Division; 2) community visioning for the Innovation Way project ; and 3) details about Innovation Way alternative growth scenarios and public feedback from the CPC Summit held in Orlando, Florida, October 27-30, 2005.

A Special Thanks to CPC Partners

The Orange County Planning Division Linda Chapin, Metropolitan Center for Regional Studies at the University of Central Florida

Jeffrey Jones, East Central Florida Regional Planning Council Shelley Lauten, myregion.org

Three day charette process involving:

- Planners and decision makers
- Citizens and stakeholder groups
- Civic engagement facilitators
- Tool providers and planning consultants
- 1. Evaluated 5 existing scenarios
- 2. Determined strengths & weaknesses
- 3. Revised scenarios & re-evaluated
- 4. Identified best scenarios

PARTICIPATING TOOL PROVIDERS

CRITERION PLANNERS PLACEWAYS/COMMUNITYVIZ ENVISION SUSTAINABILITY TOOLS FORSEE CONSULTING INFRACYCLE NATURESERVE RENAISSANCE PLANNING GROUP THE FLORIDA NATURAL AREAS INVENTORY THE PROJECT INTEGRATION PROCEDURE WINSTON ASSOCIATES

PUBLIC PARTICIPATION EXPERTS

BILL LENNERTZ, NATIONAL CHARRETTE INSTITUTE GIANNI LONGO, ACP VISIONING AND PLANNING, LTD. GEORGE JANES, ENVIRONMENTAL

SIMULATION CENTER

Habitat Planning Charette

Objectives

- Understand the habitat content and its value to the region and Florida
- Understand the areas of importance, conflict, and compatibility with the scenario
- Develop policy recommendations regarding what should be protected and where





ΓА

The Conservation Elements

Selected Elements

- scrub
- sandhill
- gopher frog
- red-cockaded woodpecker
- celestial lily
- wood stork
- bald eagle
- Florida sandhill crane
- flatwoods
- eastern indigo snake
- wetlands
- watersheds







Red Cockaded Woodpecker

- A Federal Endangered Species with required protection
- Distribution based on potential habitat
- Ground surveys required to verify
- Development restrictions and/or HCP may be required

Blue occurrences meet adequate size requirements, red areas are below minimum size but still may provide habitat.



Summary of Conservation Value

Overlays elements to show importance by richness and habitat condition

Most valuable area is within core of proposed development

Upland habitats are often undervalued for conservation in Florida





Demonstration Live Vista w/existing inputs from Quantm & CommunityViz



Conclusions & Recommendations

- Goals are more appropriately set and are more flexibly met over large regions
- Optimization of conservation solutions saves time and facilitates focus on implementation but must be done iteratively with transportation and land use tools



FL Demo Level of Effort

| Activity | Source | Approx. Time |
|---|------------------------------------|--------------|
| Input conservation data into NatureServe Vista | Florida Natural Areas Inventory | 2 weeks |
| Identify high conservation value areas | NatureServe Vista | <2 hours |
| Generate proposed highway routes | Quantm | 1 week |
| Generate secondary growth effects | Community Viz | 1.5 weeks |
| Identify areas of conflict between proposed transportation routes and conservation values | NatureServe Vista | 1 day |
| Create optimal plan via alternative land use decisions and mitigation efforts | NatureServe Vista | 4 hours |
| TOTAL | | ~4 weeks |

Planned Features for Vista 2.0

- Multiple uses per land unit (for compatibility/conflict mapping)
- User-defined element response to land use
- Assisted import from heritage Biotics system
- Tools for modeling landscape condition
- Calculating sub-region goals
 - Aquatic analysis support?
 - N-SPECT integration under evaluation





Getting Started

- Start analysis early enough to make a difference
- Appropriate definition of the regional context
- Public process for establishing values
- Investigation of existing studies, plans, priorities for conservation
- Discipline experts required
 - Ecological scientists
 - Conservation planners
 - GIS specialists



EBM Tools Program

Program Objectives

- Identify available tools that may be useful for performing ecosystembased management.
- Characterize the tools in a knowledge base
- Prioritize the tools for further description and investigation for investment
- Develop and coordinate a network of tool providers and practitioners
- Conduct outreach and training



Acknowledgments & Questions

- FHWA
- Quantm
- Placeways/Orton Family Foundation (CommunityViz)



Screenshots in lieu of Demo



Building Element Information

Each element has:

- A name
- A weight
- A conservation unit
- Categories
- A quantitative goal
- Compatibility to land use types
- A spatial distribution map

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Setting Goals and Weights

| Edi | it Goal Set | | | | | | |
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| | Default Goal | | <u> </u> | | | | |
| Cat | tegory System | G-Rank | Apply Go | pals | | | |
| EI | ement Goals | | | | | | |
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| | Calistoga ce | anothus | Imperiled(G2) | 90% of occurr | 90% of | | |
| | Green sturge | ion | Vulnerable(G3) | 60% of occurr | 60% of occurrenc | | |
| | Soft bird's-be | ak | Critically Imperil | 80% of occurr | 80% of occurrenc | | |
| | Tiburon india | an paintbrush | Critically Imperil | 80% of occurr | 80% of occurrenc | | |
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| 9(| 0% of occurrer | nces | | | Element Report | | |

- Weight elements for relative importance
- Establish goals for protection
- Used in scenario evaluation
- Typically assign minimum retention vs preferred goalsets
- A single scenario can be evaluated against multiple goalsets
- Goals based on % of habitat, % of occurrences, absolute amount of habitat, or absolute # of occurrences



Element Report

Shows all attributes of an individual element

- Written in XML
- Presented in browser using HTML

| Aldo Report: | Element - Mic | crosoft Internet Explorer | |
|-----------------------|----------------------|---|----------------|
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| Con | mon name | Northern spotted owl | |
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| Category S | tatus: | | |
| G-F | ank: <u>Vulneral</u> | ble(subspecies or varieties)(T3) | |
| | | Vulnerable globally either because very rare and local throughout its range, found only in a restr range (even if abundant at some locations), or because of other factors making it vulnerable to extinction or elimination. Typically 21 to 100 occurrences or between 3,000 and 10,000 individ | icted luals |
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| | | Federally listed as Threatened | |
| Cali | fornia legal s | status: None(NO) | |
| | | None - no State status | |
| Conservatio | n Value Ma | ap: | |
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Indices of Conservation Value

Allows the user to:

- Select elements to be included.
- Select the factors to be included such as quality, confidence, and weight.
- Each combination reveals different information (e.g.)
 - Integrated Cons.
 Value
 - Element richness
 - -Viability
 - Ave. confidence



Scenario Evaluation Report

Land Use Conflict Map

- Red areas indicate elements with unmet goals and incompatible land use intent.
- Darker shades indicate richness of elements in conflict.



Scenario Evaluation Report

Policy Conflict Map

- Red areas indicate elements with unmet goals and unreliable protection policies.
- Darker shades indicate richness of elements in conflict.



Scenario Evaluation Report

* Evaluation Report : Rarity evaluation

@fod. @fineer: €Step ≥Retract @Pint] Expet Show/ML \$€Customes

Report

Scenario Evaluation

| Name | Ranty e | mination | | | | |
|--|---|--|---|--|--|--|
| Scenario | NapaC | Sourty baseline | | | | |
| Cell size | 500 sq | uare meters | | | | |
| Evakaates | Land Use Compatibility and Protection Policy | | | | | |
| Policies considered to offer "Protection" | • 1 • 1 • 1 • 1 | Legislatively/A Revocable legi Statutory enfor Institutionally n Unknown | dministrativel (latively/adm ted land use lanaged ease | ly manclated land use inistratively manclated land plan ment or holding | | |
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| Summary | | Goals met fo | ć. | Goals unnet for | | |
| Protected and Compa | tible | 0 elements | 0% | 38 | | |
| Comp abble | | 3 elements | 7.89% | 35 | | |

Element details

Terrestrial Ecological System 27 elements

| | | Distribution | | Protected and Compatible | | Compatible | | | | |
|-------|--|-------------------------|------|--------------------------|-------------------------|------------|--------------------|-------------------------|------|-------------------|
| P&C C | Name | Area (square meters) | Occs | Goal | Area (square meters) | Occs | Percent of goal | Area (square meters) | Occs | Percent - goal |
| | California Annual Grasslands Alliance | 862,855,899.01 | 4893 | 50 percent of area | 7,442,000 | 70 | 1.72 | 113,828,500 | 982 | 26.38 |
| | California Coast Ranges Cliff and Canyon | 11,304,992.7 | 407 | 50 percent of area | 501,500 | 16 | 8.87 | 3,485,500 | 150 | 61.66 |
| | California Mesic Chaparral | 84,559,441.82 | 1280 | 50 percent of area | 485,000 | 33 | 1.15 | 24,247,000 | 460 | 57.35 |
| | Central Valley Mixed Oak Savanna | 932,641,717.29 | 2807 | 50 percent of area | 14,601,500 | 90 | 3.13 | 89,983,000 | 698 | 19.3 |
| | Central Valley Riparian Woodland and Shrubland | 31,738,281.81 | 350 | 50 percent of area | 30,500 | 2 | 0.19 | 2,669,000 | 55 | 16.82 |
| | <u>Coastal Closed-cone Conifer Forest and</u> <u>Woodland</u> | 500,780.67 | 1 | 50 percent of area | 0 | 0 | 0 | 0 | 0 | 0 |
| | Eucalyptus Alliance | 2,288,757.62 | 79 | 50 percent of area | 88,500 | 1 | 7.73 | 241,000 | 8 | 21.06 |

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Site Explorer

- Select unit of interest
- View site and element information
- Propose alternative use
- Select implementation mechanism
- Build mitigation
 plan



Scenario Generation

- Prepare inputs for MARXAN and SPOT
- Provide policy context for refining optimized output

| Generat | e Conservation Sol | ution | | |
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Create Solutions, Identify "Irreplaceable" Sites

Identify a set of locations that can meet conservation goals at least cost or conflict with production objectives

Calculate the relative irreplaceability of sites for meeting conservation goals

Proposed Conservation Areas

